3D DISPLAY APPARATUS AND CONTROL METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2015-0144698, filed on Oct. 16, 2015 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Field

[0003] Apparatuses and methods consistent with exemplary embodiments relate to an autostereoscopic three-dimensional (3D) display apparatus and a control method thereof, and more particularly, to a 3D display apparatus which provides a 3D image by rendering more image views than optical views, and a control method thereof.

[0004] Description of Related Art

[0005] With the development of electronic technology, various types of electronic apparatuses have been developed and become widespread. In particular, display apparatuses, such as televisions (TVs), which are one of the most commonly used home appliances, have been rapidly developed in recent years.

[0006] With improved performance of display apparatuses, the type of content available to be displayed has increased. In particular, stereoscopic display systems capable of displaying three-dimensional (3D) content have recently been developed and become widespread.

[0007] The stereoscopic display apparatuses may be implemented within various types of display apparatuses, such as a monitor, a portable phone, a personal digital assistant (PDA), a personal computer (PC), a set-top PC, a tablet PC, an electronic photo frame, a kiosk, or a 3D TV. The 3D display technology may be used in homes, as well as in various fields necessary for 3D imaging such as science, medicine, design, education, advertising, or computer gaming.

[0008] The stereoscopic display systems may be categorized as autostereoscopic systems that allow a user to view 3D images without glasses and stereoscopic systems that require a user to wear glasses to view 3D images.

[0009] The stereoscopic system may provide a satisfactory 3D effect, but inconvenience the viewer by requiring glasses. In comparison, the autostereoscopic system does not require a user to wear glasses to view 3D images, and thus there has been steady development of autostereoscopic systems.

[0010] Image quality of a 3D image may be affected by contrast, flicker, crosstalk, or the like in the autostereoscopic system. Crosstalk is a phenomenon where left-eye and right-eye images are mixed. For example, a left-eye image may be mixed with a right-eye image and viewed through the right eye, or the right-eye image may be mixed with the left-eye image and viewed through the left eye. The sharpness of the 3D image may be degraded due to the crosstalk.

SUMMARY

[0011] Exemplary embodiments may overcome the above disadvantages and other disadvantages not described above. Also, an exemplary embodiment is not required to overcome the disadvantages described above, and an exemplary embodiment may not overcome any of the problems described above.

[0012] According to an aspect of an exemplary embodiment, there is provided a three-dimensional (3D) display apparatus including: a display including a display panel and a viewing area separator disposed on a front side of the display panel and configured to provide a plurality of optical views having different viewpoints to a viewing zone; and a processor configured to render a plurality of image views having different viewpoints based on a depth of an input image and provide a multiview image by arranging the plurality of image views on the display panel in an arrangement pattern. The processor is further configured to determine, based on the arrangement pattern, an estimated crosstalk occurring between the plurality of image views having the different viewpoints, correct the plurality of image views by performing crosstalk inverse compensation according to the estimated crosstalk, and provide the multiview image based on the crosstalk inverse compensation.

[0013] A number of the plurality of image views may be greater than a number of the plurality of optical views, and each of the plurality of optical views may be provided based on at least two image views of the plurality of image views having different viewpoints.

[0014] The processor may be further configured to determine the estimated crosstalk based on a difference between an output pixel region of the display panel and a corresponding visible pixel region provided through the image views.

[0015] A plurality of visible pixel regions may be tilted at a preset angle corresponding to the plurality of optical views, the plurality of visible pixel regions being separated by the viewing area separator, and the processor may be further configured to perform theoretical crosstalk modeling on a reference image view based on the preset angle, the number of image views, and a rendering pitch.

[0016] The processor may be further configured to perform the theoretical crosstalk modeling on the reference image view based on the preset angle, the number of image views, the rendering pitch, and reflecting a Gaussian optical profile to the modeled theoretical crosstalk.

[0017] The processor may be further configured to calculate a crosstalk occurrence weight for at least one image view of the plurality of image views which provides the crosstalk to the reference image view based on the preset angle, the number of image views, and the rendering pitch, and perform the crosstalk inverse compensation by generating a crosstalk matrix according to the calculated crosstalk occurrence weight.

[0018] The processor may be further configured to generate an epipolar image by combining a plurality of pixel lines of the plurality of rendered image views, and perform the crosstalk inverse compensation by applying a crosstalk inverse filter to the generated epipolar image, and the crosstalk inverse filter may generate an inverse matrix of the crosstalk matrix.

[0019] The processor may be further configured to adjust a filtering coefficient of the crosstalk inverse filter based on a characteristic of the input image and perform the crosstalk inverse compensation by reflecting the adjusted filtering coefficient.

[0020] The processor may be further configured to divide the crosstalk inverse filter into an angular smoothing filter and an angular sharpening filter, and adjust the filtering